

Source

■ **Electronic Industries Foundation (EIF)**
919 18th Street, NW
Suite 900
Washington, DC 20006
202/955-5814
TT: 202/955-5836

Description

Founded in 1975 by the Electronic Industries Association, EIF operates the Technology Applications Program, which provides general information on assistive devices, their applications and referrals for technical assistance.

■ **National Easter Seal Society**
230 West Monroe Street
Suite 1800
Chicago, IL 60606-4802
800/221-6827
TT: 312/726-4258

Founded in 1919, the Society helps identify the needs of people with disabilities and provides various services to meet those needs. Nationwide network provides extensive information and referral services.

■ **National Information Center on Deafness**
Gallaudet University
800 Florida Avenue, NE
Washington DC 20002
202/651-5051
TT: 202/651-5052

Provides either direct information or appropriate references to deaf or hearing impaired individuals. The Center also publishes brief resource listings and descriptive fact sheets on requested topics for a nominal fee.

■ **Trace Center**
University of Wisconsin
Waisman Center
1500 Highland Avenue
Madison, WI 53705
608/262-6966
TT: 608/263-5408

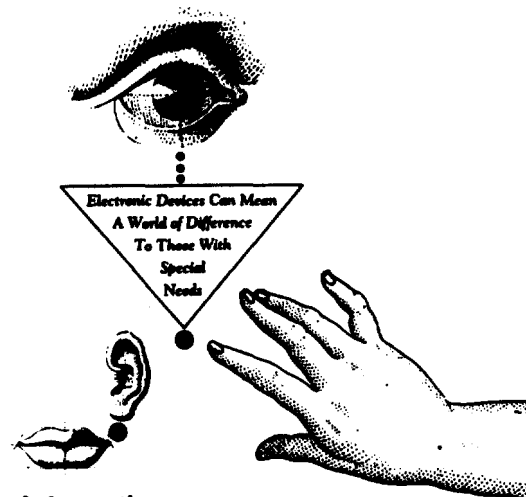
One of the leading centers for development and evaluation of computers and adaptive devices. Provides information related to non-vocal communication, computer access, and technology for disabled persons.

■ **Self Help for Hard of Hearing (SHHH)**
7800 Wisconsin Avenue
Bethesda, MD 20814
301/657-2248
TT: 301/657-2248

Sponsors an Assistive Devices Center which helps deaf and hard of hearing individuals identify assistive devices appropriate for their needs. Offers referrals and publication catalog for a nominal fee.

Consumer Electronic Manufacturer's Association
2500 Wilson Boulevard
Arlington, Virginia 22201-3834
(703) 907-7600

EXTEND THEIR REACH



For More Information

There are several groups which provide general information on assistive devices. Consider contacting the following:

Source

■ **American Foundation for the Blind (AFB)**
11 Penn Plaza
Suite 300
New York, NY, 10001
(800) 232-5463

Description

The AFB hotline supplies information on visual impairment and blindness, AFB services, technology, products, publications, training programs, funding sources and more.

■ **The Association for the Advancement of Rehabilitative Technology**
1101 Connecticut Avenue, NW
Suite 700
Washington, DC 20036
202/857-1199

An interdisciplinary association for advancement of rehabilitation and assistive technology. Offers referrals.

■ **Center for Special Education Technology**
The Council for Exceptional Children
1920 Association Drive
Resdon, CA 22091-1589
703/620-3660

A national information center funded by the U.S. Department of Education, Office of Special Education Programs. Distributes information on assistive-technology, funding strategies, and technology training.

Products and Services to Assist People With Disabilities

ADD Member Companies Voice/Text Telephone#	Alternative Computer Input (keyboards, pointers, etc.)	Alternative Telephone/ TTY Systems	Assistive Listening Devices	Augmentative Communications	Braille Embossers/Printers	Braille Text Display	Close Caption Decoders	Electronic Magnifiers	Enlarged Video Display	Environmental Controls	Icon-Directed Commands	Laser Pointers	Monitoring Services	OCR/Scanners	Personal Assistant/ Security Devices	Special Needs Telephones	Special Software	Speech Synthesis	Text Telephones	Voice Input
Apple Computer, Inc. (800) 800-7808 / (800) 755-0601 e-mail: apple.dsg@apple.com	●			●	●				●	●	●		●	●			●	●	●	●
AT&T (800) 233-1222		●	●										●			●			●	
BEL-Tronics LTD (770) 385-7812												●								
Blazie Engineering (410) 893-9333	●	●			●	●									●			●		
Command Communications (303) 751-7000																●				
DesignTech International, Inc. (800) 337-4468			●							●					●	●				
Digital Equipment Corp. (DEC) (800) 344-4825 (Voice & TT)	●	●	●	●	●	●			●	●	●		●	●			●	●	●	●
EEG Enterprises (516) 293-7472							●													
General Physiotherapy (314) 291-1442															●					
HARC Mercantile Ltd. (800) 445-9968		●	●	●			●		●						●	●	●		●	
Innovations, Inc. (800) 854-6554								●												
Intellitools (800) 899-6687	●																●	●		
IBM Corp. (800) 426-4832 / (800) 426-4833	●			●		●			●	●	●				●		●	●		●
Jasco (405) 752-0710			●													●				
Lyte Optonics, Inc. (800) 255-9133												●								
Phonic Ear, Inc. (800) 227-0735			●															●		
Recoton (800) 223-6009 / (407) 333-8900			●																	
Sennheiser Electronic Corp. (203) 434-9190			●																	
WestTest Engineering Corp. (801) 298-7100	●																●			
Williams Sound Corp. (800) 328-6190, ext. 84			●	●												●				
X-10 (USA), Inc. (201) 784-9700										●			●		●					

If you are interested in a particular type of product listed here, call the companies which manufacture those products for more information and sales literature.

DESIGN FOR EVERYONE

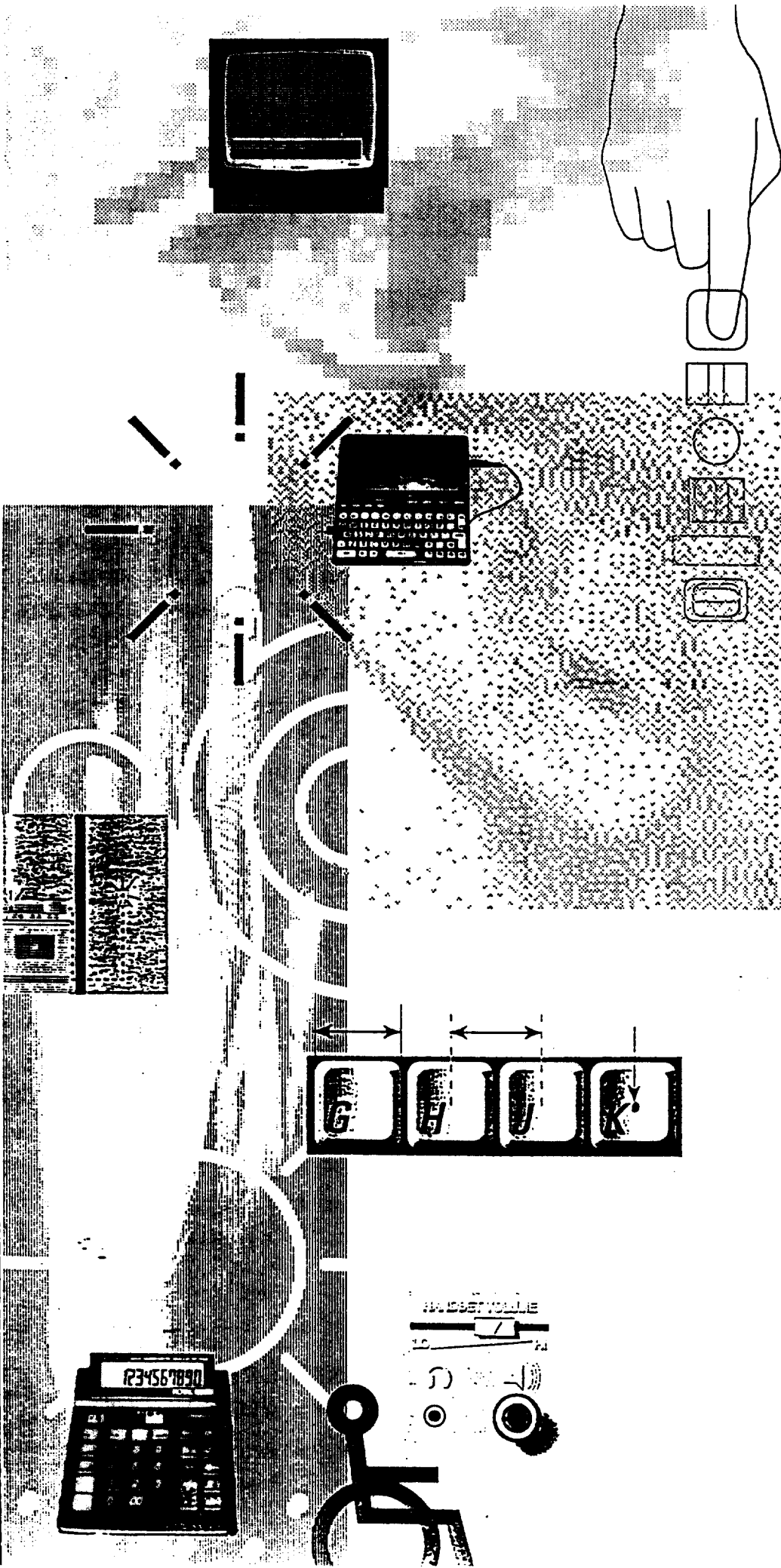
A Look

at Features

That Affect

Usability

of Consumer



Maximizing Market Share Through Design

BY DR. LAWRENCE A. SCADDEN

DR. LAWRENCE A. SCADDEN

of the Electronic Industries Foundation is currently on a two-year Intergovernmental Personnel Assignment to the National Science Foundation, where he serves as director of the Program for Persons with Disabilities.



The primary goal of commercial product designers is to maximize market share. Product acceptance and selection is based on many factors: product price, durability, maneuverability, repair issues, safety features, and appearance. Product designers and manufacturers, it follows, must operate under an array of economic and aesthetic constraints.

One factor contributing to market share that seems to be often overlooked relates to the number of potential customers who can readily use the final product. Common practices used in the design of many CE products may be limiting their sales to a significant number of potential customers—those who have a functional limitation that makes the product unusable for them. ▶

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Consumer Electronics Group

2001 Pennsylvania Avenue, NW 1500 Wilson
Washington, DC 20006-4112

A significant number of people cannot adequately use many CE products because a disability, or functional limitation, makes it difficult or impossible for them to manipulate or interact with the products. Common functional limitations include hearing impairments, visual impairments, perceptual difficulties, limited dexterity, and restricted range of motion. A sensory impairment, for example, may bar access to visual or auditory information. Many cognitive or perceptual impairments can produce similar effects. On the other hand, restricted dexterity and limited range of motion can limit the ability to operate controls and to manipulate product components.

Demographics and Market Considerations

Data from the National Health Interview Survey indicate that approximately 32 million Americans identified themselves as having a significant functional limitation of some kind. While many have disabilities, many others are older people who have developed a functional limitation due to the aging process.

The U.S. is experiencing an expanding proportion of older citizens. In 1989, 31 million people were 65 or older—one out of every eight Americans. This figure represented an increase of 21% since 1980. The most rapid increase for this population will not come until the years between 2010 and 2030, when the Baby Boom generation reaches 65.

The observations regarding the country's older population deserve special attention:

- ▶ The fastest-growing age segment of the population is comprised of people 85 and older.
- ▶ The likelihood of acquiring chronic health conditions and functional limitations increases with age.
- ▶ Financial analysis shows that people over the age of 65 comprise the population group with the largest amount of disposable funds that can be allocated for consumer products.

Accessible Design

The term *accessible design*, or *universal design*, refers to maximizing the number of potential customers who can readily use a product. No design can be accessible to everyone, but companies must move in that direction.

Accessible design can impact market size and market share through considering the functional needs of persons with disabilities and functional limitations. It will assist designers select features that make products useful to the largest number of consumers. Product features that make products usable by persons with disabilities or functional limitations normally make them convenient for everyone else. Incorporation of appropriate human factors, therefore, does not necessarily imply design for a specialized disability market niche. It opens the market to everyone.

Product Accessibility

Products can be made accessible, or usable, through three key approaches.

1. Built-in features. Products will be accessible when their built-in features, such as controls and displays, can be used effectively and independently by persons with functional limitations.

2. Add-on options. Alternative options available to consumers can make consumer products accessible. Braille overlays, for example, are offered by several CE companies, enabling blind users to use the controls. Similarly, computer operating systems may contain utilities that allow users to enter commands by pressing keys sequentially rather than simultaneously.

3. Use of assistive devices. Accessibility or useability can be achieved through the attachment of an assistive device. An individual

with impaired hearing, for instance, can use a handheld amplifier to increase the amplitude of a telephone or other auditory output, and synthetic speech can substitute for visual informational displays on many products. Also, remote controls are considered to be convenience items for most consumers, but they serve as essential assistive devices and environmental controls for persons with severe motor impairments.

All three approaches to accessibility are appropriate. The key to accessibility normally rests with making controls and informational displays useable. (February's article will focus on specific functional limitations and common design solutions.)

CEG's Office of Member & Industry Relations will be pleased to provide referrals to members seeking additional information. Call 202/457-8719. ♦

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Vision Impairment and Product Design

Operation of consumer electronics is often mediated by vision. Vision is used to locate and identify controls, monitor control settings, and read instructions and informational displays.

Millions of consumers with severe visual impairments have difficulty using products when vision is required for adequate product operation, and even consumers with full sight will find use of these same products to be inconvenient when visual attention must be divided between two activities and when illumination is inadequate.

User-Friendly Products

"Accessible design" refers to maximizing the number of potential customers who can readily use a product. For consumers with visual impairments, and for sighted consumers using products under less-than-ideal conditions, accessible design means that the need for vision for adequate product operation should be reduced as much as possible.

This article describes the magnitude of the problem, common difficulties caused by product design, and design options which can help manufacturers increase sales of their products.

Demographics

National data indicate that a minimum of seven million Americans have severe visual impairments—the inability to read normal news print without special assistive devices. About 90% of these individuals have some useful residual vision that can be used to conduct vision-mediated activities, such as

independent travel or reading (but then conducted typically with the aid of special devices).

Only about 10% of the severely visually impaired population is considered to be totally blind. Over two-thirds of the severely visually impaired population are over the age of 65, so many of these individuals have other physical or sensory limitations as well (most commonly, problems with balance, dexterity, or hearing). These additional limitations may also affect the appropriateness of product features as they affect product usage.

Product Controls

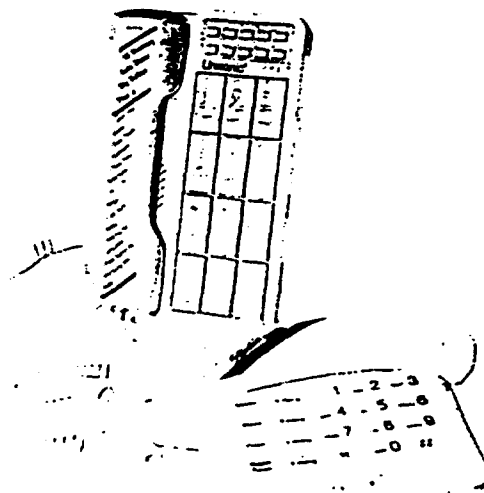
The properties and configuration of product controls can seriously affect their independent use by persons with visual impairments. Controls must be physically accessible, maneuverable, identifiable by visual or tactile distinctiveness; and they should have redundant operational feedback.

Effective use of product controls is influenced by the relative ease of locating and identifying them. Control discriminability is enhanced significantly by distinctive visual and tactile characteristics. Distinctiveness can be provided by altering control size, height, texture, and color.

Control location can also affect its identification and operation. Controls are difficult to identify by touch when they are recessed or tightly clustered, especially miniature switches.

Membrane Switches

Membrane switches and control panels can be among the least accessible form of product controls for visually impaired consumers, but the problem can be readily resolved. Products operated from flat panels containing switches activated by light pressure, heat, or capacitance, may begin to operate in an unanticipated manner when a visually impaired consumer touches the product to become oriented to it. These panels need tactually discernable points or boundaries to indicate active regions. Some manufacturers design tactually discernable regions onto their membrane panels, and many others provide braille and other tactile overlays that can be placed over the panels.



Operation of membrane panels also requires detectable feedback so that products can be operated without vision. Activation of a membrane switch normally cannot be sensed unless a sighted user is monitoring a visual display. Auditory clicks, beeps, or tactually discernable switch movement can provide the desired operational feedback information for a person with vision loss.

Position of Controls

Desired product operation is often dependent on setting and monitoring the position of a product control. Many product controls are difficult to monitor unless the user is observing a visual display. Electronic controls that change an operational parameter continuously until it is deactivated cannot be monitored by users who have visual impairments unless the parameter being changed is an auditory signal, such as pitch or volume. Redundant operational feedback—visual, auditory, and tactual—is valuable for most consumers at some point because noisy and bright environments may mask the pre-

sensation of important auditory or visual signals even for consumers with full sensory capabilities.

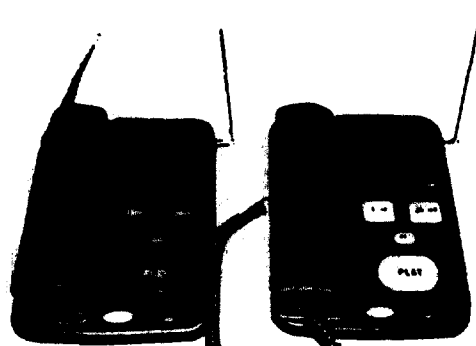


Rotary Knobs

The position of a rotary knob may provide blind

users with a special challenge. The knob may be turned, but the distance moved may be difficult to judge without visual or tactile feedback. Knob asymmetry will provide information concerning relative position. Pointers, dots, and recessed notches are all commonly used on rotary knobs for this purpose. Many persons with visual or dexterity impairments often find slide switches easier to operate, and their relative position can be easily monitored tactually.

Similarly, the current status of a control is essential for good product operation. Visual markings provide this information for sighted users. Tactual and mechanical indicators can provide the same information for many others who have sight limitations and for sighted users when they are operating products under low illumination or when vision must be directed elsewhere. A mechanical detent or click can serve this purpose for most rotary knobs and slide switches.



Informational Displays

Product operation is facilitated by presenting easy-to-read visually displayed information. Letters and numbers should be

simple, large, well-illuminated, and have high contrast. Alphanumeric characters are also easiest to read when they contain a high ratio of character openness to the thickness of the character strokes.

The location of visual displays is also a concern for many users. Visual displays should not be placed at locations that require users to bend down to read them. Angling such displays upward can eliminate discomfort, and even injury, for many consumers.

Operating Instructions

Operating instructions and user manuals should be written in clear, easy-to-follow English (or other language as appropriate). Recorded, Braille, large-print, and diskette-stored manuals are valuable alternatives for many users with visual impairments.

Instructions printed on, or inside, appliances should be easily accessed without unnecessary physical effort, and they should be printed in large, high-contrast characters. Consumer products are commonly placed in locations with illumination levels that are below that found in laboratories and showrooms.

Consideration of features discussed in this article can make products less difficult for many people to use and more convenient for all consumers in some situations. People cannot always direct their entire attention to the operation of a product and the products will not always be located in ideal locations.

Accessible design is good for building market share, acceptance and use by everyone, and it will provide persons with disabilities and functional limitations the ability to benefit independently from these products.

CEG's Office of Member & Industry Relations will be pleased to provide referrals to members seeking additional information. Call 202/457-8719. ♦



Making It Right For Those With Motor Disabilities

Discussion of motor disabilities typically elicits thoughts of mobility impairments, or more specifically, the needs of the millions of individuals who use wheelchairs for independent travel. However, individuals with more common difficulties such as arthritis, poor balance, or lack of grip strength also experience problems operating certain consumer electronics. Considering switch placement, user strength requirements and related factors during the product design phase will enhance user-friendliness for all.

Mobility Impairment

Operation of consumer products can produce problems for individuals with mobility impairment when product controls are located at a height or distance that makes it difficult for them to be reached. These accessibility problems usually can be eliminated by better placement of the product, with the use of a power strip, or through selection of products with front-mounted controls.

Similar problems and solutions associated with the operation of consumer products must be considered for the approximately 12 million Americans who have poor balance or chronic back problems. Controls located at the back of consumer products produce difficulties—and even danger—for these millions of individuals. Discomfort or injury may result from falling forward. This problem is exacerbated when the controls are located at the rear of a heating surface, such as a cooking range. Garments or skin are endangered by the combination of the functional limitation and the heat.

Larger Audience
Millions of people have other types of motor limitations that can seriously affect

product operation and thus its value. Demographic data from the National Center on Health Statistics indicate that millions of Americans identify themselves as having motor limitations that are not related to their lower extremities.

Analysis of these data suggest that 15 million is a conservative estimate for the number of Americans who have difficulty reaching, lifting, handling, or otherwise manipulating objects. These functional limitations range from total inability to use one's upper extremities to difficulty in tasks requiring fine-motor finger dexterity needed to manipulate small items. Individuals located anywhere on this continuum will experience difficulties in operating many consumer products.

At one extreme, some require use of a mouth- or head-wand to push buttons or flip switches. Others may lack the strength to lift, hold, and manipulate products. Still others may lack the coordination or hand control needed to locate and operate small controls. Finally, many of these

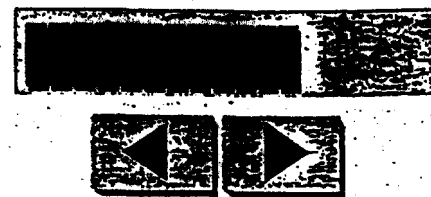
individuals have one strong, well-coordinated hand; but lacking two hands, they have significant difficulty in assembling and disassembling products and operating two controls simultaneously.

With current designs, many consumer products are inaccessible to these individuals because they cannot use the products independently. Consumer products, however, can be designed to make them accessible, useful, and

desirable for these millions of consumers. These design considerations also make product operation more convenient for everyone.

Product Controls

Products are inaccessible and have no value when consumers cannot locate and operate the product controls without difficulty. Product con-

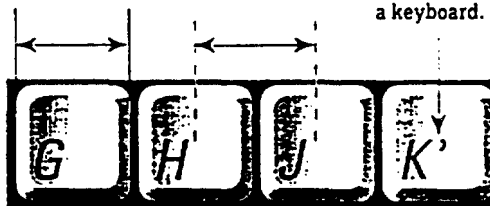


Visual feedback, such as an LCD display, is helpful to those with motor impairment.

Optimum size for push-button controls/keys is a 1/2" square.

Keys/buttons should be placed on 5/8" centers.

Tactile clues help the visually impaired orient themselves to a keyboard.



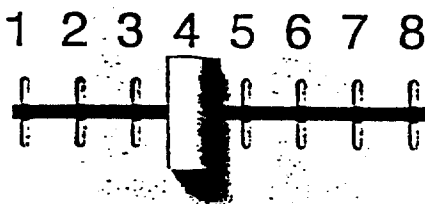
controls should be physically accessible and maneuverable. Many individuals with limited dexterity have difficulty locating, identifying and manipulating miniature switches, especially when they are recessed or closely clustered together.

The diversity of functional abilities of persons with motor limitations makes it difficult to quantify the optimal parameters for product control size and required pressure. However, a recent internal study conducted by AT&T with the assistance of rehabilitation centers provided valuable information that may serve as guides for others. Individuals with severe motor impairments—including quadriplegics and people with cerebral palsy—could operate buttons on standard telephones without much difficulty, even when using mouth- and head-wands. Smaller buttons decreased accuracy, while larger ones tended to produce disorientation or difficulty caused by the need for increased range of motion.

Results from this study indicated that push-button controls, approximately one-half-inch square with slightly concave surfaces, placed on five-eighth-inch centers, can be readily used by most consumers. It was also determined that the force required to depress the buttons on standard telephones was appropriate for the participants with severe motor limitations. Finally, visual feedback for button activation was desired by participants using wands and those with hand tremor or tactile limitation.

Rotary Knobs

Rotary knobs can cause special problems. Small knobs that require grasping and turning are difficult for many people to use if they have dexterity or upper limb motor impairments. Large knobs may be operated with a sliding motion of the hand or finger, but the distance moved may be difficult to judge without visual feedback. Many persons with either dexterity or visual impairments often find slide switches easier to operate,



Persons with dexterity or visual impairments often find slide switches/controls easier to use than rotary dials. Additional tactile feedback can be provided through the use of click-stops.

and their relative position can be monitored tactually.

Voice Recognition

The increased use of voice recognition systems for the control of consumer products is, like remote control systems, aimed at providing convenience for all product users. In both situations, many people with motor impairments benefit directly by having independent control of the products. These control systems move beyond being an element of convenience to one of necessity.

One-Handed Operation

Consumer products are more accessible for

everyone when they are designed to be used with one hand. Product operation is often facilitated when the user can keep one hand free for other activities.

Many individuals with restricted motor abilities are unable to press multiple keys or switches simultane-

ously. Computer commands, printer settings, and recorder operations are common examples of product usage requiring simultaneous activation of more than one key or switch. One-handed operation of all products is also obviously essential for individuals who have only one functioning hand.

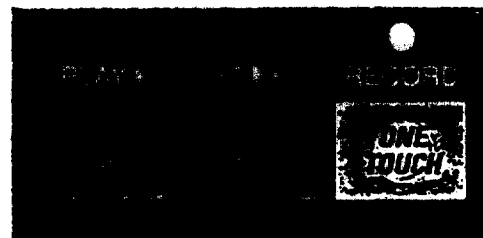
Disassembly and Reassembly

Products designed to be portable often need to be disassembled and reassembled. Many household products require selection and installation of product components appropriate for specific tasks to be performed. Latches on such products should require use of one hand and a minimum amount of strength. Hand and arm strength should not be essential for independent consumer product disassembly or reassembly activities.

Good For Business

Accessible product design is good for building market share, acceptance and use by everyone. It will provide persons with motor disabilities and functional limitations the ability to benefit independently from these products.

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One-handed operation, combined with visual clues, is essential for those with severe motor impairments.

Auditory Loss and Accessible Product Design

The importance of an adequate auditory sense can best be illustrated by listing its common functional uses: interpersonal communication, either face-to-face or by telephone; acquisition of information from lectures, radios, televisions and recorded tapes; and warning signals and indicator alarms on vehicles, smoke detectors, clocks, and home appliances. Access to the information emitted by these sources of audio information is crucial to safe and productive performance of many daily activities. Auditory augmentation or substitution is essential for millions of individuals who are deaf or hard-of-hearing.

Demographics of Hearing Loss

Hearing loss is considered by many to be the most common form of functional limitation or disability. National statistics indicate that approximately 23 million Americans have a degree of hearing loss that may affect their functioning. The majority of these individuals, how-

ever, function with a minimum of difficulty in most situations with minor adaptations, such as raising the amplitude of audio equipment or by turning their heads to maximize use of their dominant ear. Many others, however, have hearing deficits that require significant adaptation and that affect their use of consumer products.

Data on individuals who are either deaf or severely hard-of-hear-

ing indicate that approximately eight million people have a significant bilateral hearing loss but can understand speech with amplification provided by hearing aids, assistive listening devices, hand-held amplifiers, and amplified telephone receivers.

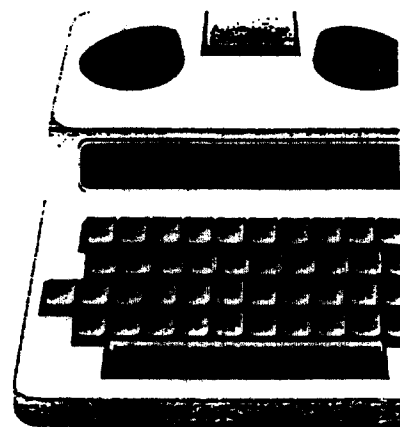
Another two million individuals have severe bilateral hearing losses that require augmentation of information normally presented through speech; and approximately 500,000 individuals are profoundly deaf and require alternative means of obtaining information normally presented through the auditory channel. As with other functional limitations—visual, motor, and tactual—serious hearing loss is often associated with age, and many of these individuals commonly have multiple functional limitations.

Access to Consumer Electronics

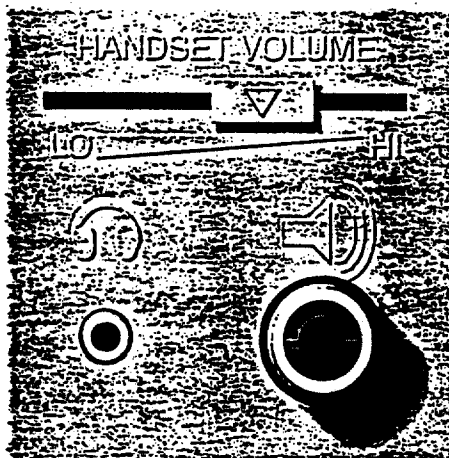
The first article in this series on accessible product design stated that products can be made accessible, or useable, through three approaches: 1) use of built-in features, such as accessible controls and displays; 2) use of add-on options, such as braille overlays or special computer utilities; and 3) use of assistive devices.

Access to consumer electronics by people who are deaf or severely hard-of-hearing is often mediated by assistive devices. An individual who is hard-of-hearing, for example, may use an amplifier to increase the amplitude of a telephone or other auditory output. The amplifier may be hand-held, or it may be built into the audio system, or it may be linked by assistive listening devices (ALDs) that use infrared or FM RF (radio frequency) beams to provide increased amplification of a selected sound source.

Other assistive devices have been developed to provide deaf individuals alternative methods to communicate and to obtain televised information. The text-phone, or telecommunication device for the deaf (TDD), permits two-way telecommunications with others using similar devices or through



Digital displays and printouts, such as those used in TDD equipment, can provide visual feedback.



The inclusion of volume controls or headphone and speaker jacks allows those with minor hearing loss to adjust audio output to levels that are effective for themselves.

the mediation of individuals who serve as vocal relays. Installation and operation of relay services was mandated under provisions of the Americans with Disabilities Act (ADA).

Text-based information services are also being made accessible to individuals using text-phones paralleling voice-based information systems activated by touch-tone telephones. Text-phone users will now have equal access to the information previously restricted to hearing individuals.

The use of closed-captioning of language spoken on television broadcasts was also encouraged through legislation (the Television Decoder Circuitry Act). The Act mandates that all televisions, 13-inches or larger, manufactured for sale after July, 1993, must contain a built-in decoder chip for closed-captioned programming.

Accessible Design of CE Products

Consideration of accessibility issues during the design of consumer electronics can increase their usefulness to many individuals with severe hearing loss. As stated previously, "accessible design" refers to maximizing the number of potential customers who can readily use a product. When designers seriously address the accessibility problems of people with hearing deficits, the market value of the resulting products is significantly heightened for these consumers, and the products usually will be more convenient for everyone else.

For example, audible beeps commonly used as feedback for control operation, auditory alarms, warning buzzers or sirens, synthesized voice guides, or other audio sources will not be detected by a person who is deaf or severely hard-of-hearing. Inclusion of redundant visual information is essential for these consumers, but

they are also useful to individuals operating in noisy environments. Noise often can mask the presentation of important auditory signals even for people with normal hearing capabilities, just as glare or high illumination can mask visual signals.

The redundant display of informa-

tion is important, but even the addition of a light or other visual display to parallel an auditory sound source (as used with an alarm or timing device) will not necessarily provide equivalent information to deaf individuals. A hearing individual, for example, can hear an auditory alarm from another room. The redundant visual display, on the other hand, will not be detected beyond line-of-sight. Remote access to such signals is a feature deserving future research and consideration as consumer electronics become more sophisticated and as CEBus® home automation standards are implemented. A product's timer or alarm system, for example, can be used to activate signaling devices located in other rooms via cable, A.C. wiring, or FM RF.

Distinct Qualities & Features

The value of auditory information displayed by consumer electronics can be maximized for all consumers, but especially those who are hard-of-hearing, through inclusion of distinctive qualities and features:

- 1) Auditory signals should be clear, not ambiguous.
- 2) They should have user-adjustable amplitude.
- 3) Speech or coded tones should have adjustable speed or be slow by default.
- 4) Consideration should be given to providing private listening capability.

Many of these qualities can be offered to individuals who are hard-of-hearing through the use of assistive listening devices, but consumer electronics must contain a means by which the auditory signal can be detected and then transmitted by the infrared or FM transmitter. Appropriate earphone jacks or external speaker connectors will expedite use of these devices.

Increased Market Share

Accessible design can increase market share by promoting acceptance and use by everyone. It also enables people with disabilities and functional limitations to enjoy and profit from the use of consumer electronics. ♦

Planners of future home automation equipment should consider the need for visual—as well as audio—alarms and signals that will maximize effectiveness for all.



The use of closed-captioning circuitry is one way in which the electronics industry is adapting to the needs of the hearing-impaired.

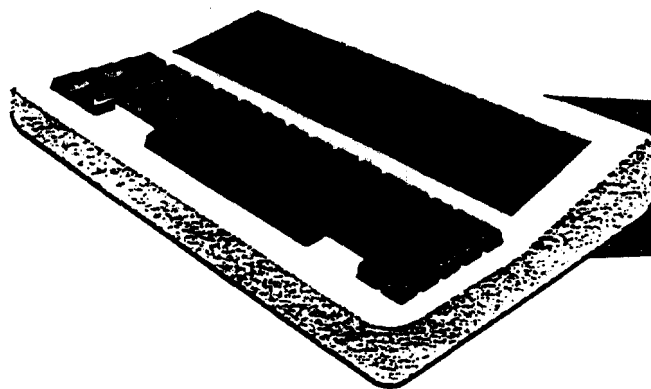
Working Toward Total Product Accessibility

Previous articles in this series suggested that principles of accessible design can result in consumer electronic products that can be used by the vast majority of all consumers including most of the 42 million Americans who identify themselves as having some form of functional limitation, many of whom are older citizens. Such design principles can increase market share because features that make products usable by persons with functional limitations and disabilities normally make them convenient for everyone else.

In brief, previous articles stated that product accessibility can normally be provided for most consumers through built-in features, add-on options, or with use of assistive devices. Most commonly, accessibility is achieved through making controls and informational displays usable by the largest number of consumers.

The Total Access System

ACCESSOR



A variety of accessors match the input needs of disabled users

General Design Principles

Problems of accessibility are most frequently caused by the inability of a product user to locate or identify controls, monitor control settings, or read instructions and informational displays. Consumer electronics usually can be made accessible for most product users by heeding the following principles:

- ▶ Distinctive characteristics—size, height, texture, and color—improve control identification.
- ▶ Controls should be readily reached and operated.
- ▶ Membrane switches need tactually discernable points or boundaries provided by embossed grids or tactile overlays.
- ▶ Detectable feedback from audible clicks, beeps or tactually discernable switch movement permit products to be operated without vision.
- ▶ Rotary knobs should have pointers, dots, or recessed notches to indicate their position.
- ▶ Mechanical detents and clicks can provide information concerning control settings for most rotary knobs and slide switches.
- ▶ Easy-to-read visually-displayed information facilitates product operation. Characters should be simple, large, well-illuminated, and have high contrast and a high ratio of openness to character stroke thickness.
- ▶ Redundant visual and auditory information is essential for individuals with sensory impairments.
- ▶ Visual displays should be angled upward if they are likely to be located below head height.
- ▶ Operating instructions and user manuals should be written in clear language and be offered in alternative formats.
- ▶ Hand and arm strength should not be required for independent consumer product disassembly and reassembly activities.
- ▶ Auditory signals should be clear and have user adjustable amplitude.

Even with inclusion of these basic design

considerations, many individuals will not be able to operate consumer electronics either because their disability is severe or because product operation is complex. When discussing accessibility for people who are deaf, it was stated that a hearing individual can hear an auditory alarm from another room, but a redundant visual display will not be detected beyond line-of-sight. Remote access to such signals can be provided in the form of a visual alarm or a vibrating device.

gent products that use the CEBus® home automation standards. For example, a product's timer or alarm system can be used to activate signaling devices located in other rooms. Earphone jacks or external speaker connectors will also expedite use of assistive listening devices for individuals who are hard-of-hearing.

Moving Toward Total Access

Looking beyond individual products, consideration must be made for building accessibility into all products. A total access system (TAS) concept was developed by Neil G. Scott who continues his research at Stanford University. A TAS would connect a user of an electronic product by a high-speed bi-directional infrared wireless data link. All required accessibility functions would be performed outside unmodified electronic products that continue to perform their prescribed tasks and applications. The access functions would be handled within a personal access device, an accessor.

Products would be accessed through use of a standardized total access port (TAP) attached to the product. The TAP would serve as the interface between the host product and the accessor. The TAP would allow an accessor to enter information into the host as if it were coming from the host controls and to read information from the host informational display.

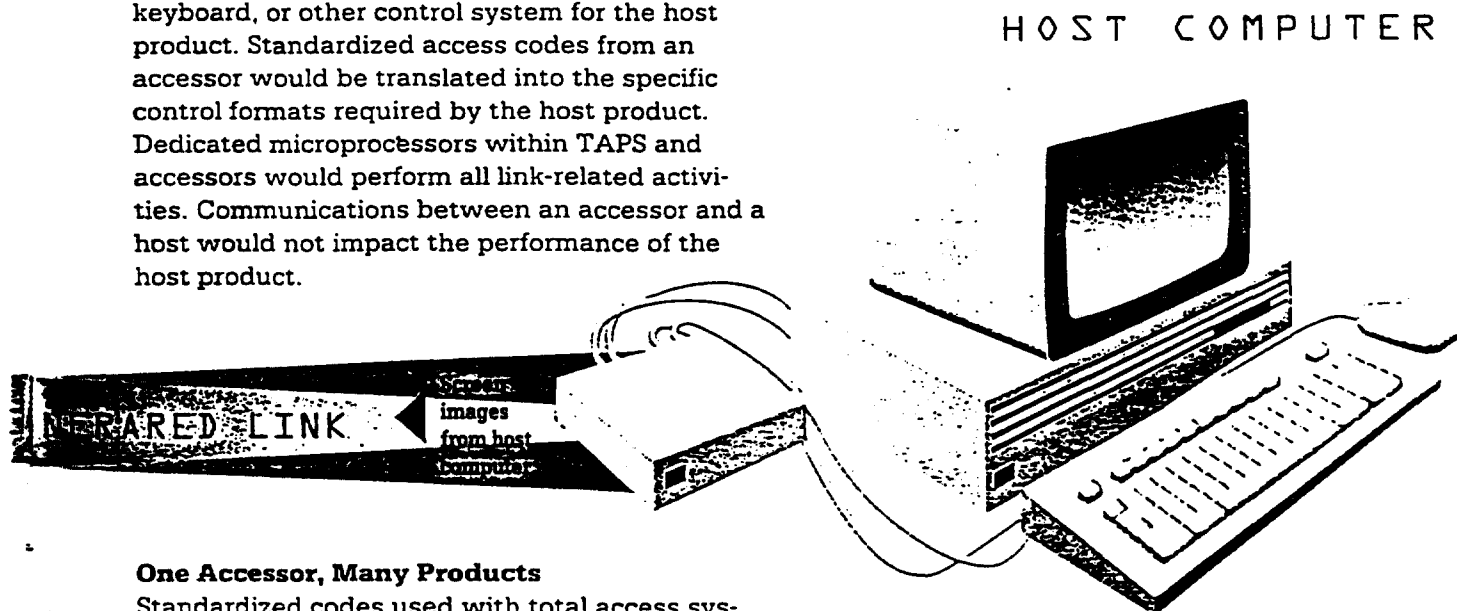
A TAP would consist of an infrared transceiver that communicates with an accessor and a microprocessor emulating a control panel, keyboard, or other control system for the host product. Standardized access codes from an accessor would be translated into the specific control formats required by the host product. Dedicated microprocessors within TAPS and accessors would perform all link-related activities. Communications between an accessor and a host would not impact the performance of the host product.

entertainment equipment, telephones, computers, information systems, security devices, lights, appliances, elevators, ATMs, vending machines, wheelchairs, and so-forth.

Federal and state laws are moving toward requiring publicly-used electronic equipment to be accessible to people with disabilities. The TAS approach could provide a solution to this problem. Such a system could also fully utilize the power of existing assistive devices currently used by many people with disabilities. Incorporating protocols used in the total access ports into the assistive devices would increase their value as they inherit the ability to interact with any product equipped with a TAP.

Implementation of CEBus home automation standards would facilitate use of total access systems by providing appropriate ports and protocols. At that point, an accessor that enables a person with a disability to use a computer would also provide environmental controls through its interface to CEBus linked products.

In summary, consumer electronics should be designed to provide independent operation to the largest possible number of potential users. Adherence to relatively simple and cost-effective design considerations will achieve this goal. Simultaneously, product designers and marketers should be looking forward to future product design which should provide all consumers increased ease of product operation, convenience, and accessibility. ♦



One Accessor, Many Products

Standardized codes used with total access systems could enable individuals with various disabilities to operate any kind of host product using their own customized accessor. Equipped with the appropriate accessor, these individuals could access any product that had a TAP. The specific requirements of different disabilities would be met through use of the customized accessors. All

Host computer runs standard applications programs

To Learn More...



This series of articles was published as a service to the consumer electronics industry by the Consumer Electronics Group of the Electronic Industries Association,

a national trade organization representing all facets of electronics manufacturing.

EIA's Consumer Electronics Group also offers generic information on products designed specifically for individuals with functional limitations. A 24-page pamphlet titled *Extend Their Reach: Electronic Devices Can Mean A World of Difference To Those With Special Needs* contains information on the general types of products available to help overcome limitations of hearing, speech, vision and motion. It also contains sections on environmental controls, computer products, funding and information sources, as well as a "who can help" section. The pamphlet is free of charge on an individual basis, and bulk orders are available at nominal rates to cover the costs of

printing, postage and handling. An audio cassette version of the pamphlet's section on products for people with vision impairment is available upon request.

In addition, EIA's Electronic Industries Foundation (EIF) offers information on sources of demographics of consumers with disabilities and referrals for additional information on product design considerations. EIF offers a series of informational pamphlets on subjects such as the Americans with Disabilities Act, tips on etiquette when working with people with disabilities, and more. The Foundation also offers information on funding of assistive technology and works with 18 Projects With Industry around the nation to offer seminars to assist human resources personnel to understand assistive technology and workplace accommodation options.

Together, EIA and EIF are a reliable source of unbiased information on products and services for individuals with functional limitations. While located in Washington, D.C., the two groups can offer referrals nationwide. For more details, call EIA at 202/457-8719 or EIF at 202/955-5810. ♦



Mr. John Hreaux
Director for Health & Safety Policy
CTIA
1250 Connecticut Ave. N.W.
Suite 210
Washington, D.C. 20036
202-785-0681 Telephone
202-785-0721 Fax

December 8, 1995

Dear Mr. Hreaux:

In response to your November 7, 1995 inquiry, the following ERICSSON manufactured phones are Hearing Aid-Compatible as defined in FCC Rules and Regulations Part 68.4, Section 68.4(3), and comply with HIA recommended standard RS-504.

Product	Model/Series	Type	FCC Id.
Ericsson	AII-2xx	AMPS	AXATR-334-A2, AXATR-345-A2
Ericsson	AH-3xx	AMPS	AXATR-334-A2, AXATR-345-A2
General Electric	CT-5xx	AMPS	AXATR-334-A2, AXATR-345-A2
General Electric	CT-7xx	AMPS	AXATR-334-A2, AXATR-345-A2
General Electric	CT-8xx	AMPS	AXATR-334-A2, AXATR-345-A2

Further testing of the following phones is on going to verify their compliance. We will keep you informed as results are available.

Ericsson	DH 3xx	AMPS/DAMPS	AXATR-335-A2
General Electric	DT-3xxx	AMPS/DAMPS	AXATR-335-A2
Ericsson	CII-337	PCS_1900	AXATR-344-A2

All of the above phones provide handsfree operation and can accommodate the HATIS device by using ERICSSON adapter KRY 105 120.

ERICSSON pledges to continue working with CTIA and others in the industry regarding Hearing Aid Compatibility.

Feel free to contact me directly at x7267 if I can be of any further assistance.

Regards:

Ronald J. Johansen
Sr. Technical Leader Acoustic/Audio

Ericsson Inc.
1 Triangle Drive, P.O. Box 13969
Research Triangle Park, North Carolina 27709
(910) 550 7000



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Two-Way Messaging Arrives

AMSD Provides Tomorrow's PCS Technology Today

The U.S. paging market is expected to lead the worldwide charge into the next generation of messaging technology.

*By Mike Maloney
Motorola*

The Federal Communications Commission defines narrowband personal communications services (PCS) as "a family of mobile services that includes advanced voice paging, acknowledgment paging, data messaging, and both one- and two-way messaging on a nationwide, regional, major trading area (MTA), and basic trading area (BTA) basis." The FCC has licensed narrowband PCS in 901 - 902, 930 - 931 and 940 - 941 MHz bandwidths (see sidebar).

By licensing a limited amount of spectrum, the FCC is counting on leading and emerging wireless service providers to drive the market by expanding today's paging industry into the world of advanced messaging communications. In fact, the FCC has said the distribution of frequencies was designed to increase competition among licensees in an effort to enhance access by the public to a greater variety of local, regional, and national service options. This move is expected to drive rapid development and deployment of

narrowband PCS services. The FCC's narrowband rules pro-

vide operators wide discretion as to the services they provide over the frequencies. Narrowband PCS will enable new technologies, including two-way, voice, and graphical messaging. However, operators still need infrastructure technology and subscriber devices along with accessible applications and content to enable business growth.

The United States hosts the world's largest and most dynamic paging market, and many expect worldwide markets to follow current U.S. trends. What is happening in the United States contradicts what many industry watchers expected. While alternative wireless communications have grown, end users also are looking for enhanced paging service - advanced messaging - to provide the benefits of cellular phone service coupled with the advantages of paging - namely, ease-of-use, convenient (small and portable) form factor, long battery life, good coverage, and low-cost service. So, while many people are buying cellular phones, vast numbers are looking to paging to con-



Len deBarros, vice president and general manager of Motorola's Advanced Messaging Systems Division, holds Tango - the first two-way, advanced messaging unit.

plement and/or replace other wireless communication tools.

AMSD Is Formed

In 1994 Motorola formed the Advanced Messaging Systems Division (AMSD), a division of the Paging Products Group, specifically to develop technologies and products to take advantage of the opportunities presented by the narrowband PCS market.

Motorola's advanced messaging development strategy is based on the FLEX™ family of high-speed protocols which includes ReFLEX™, the transport protocol enabling two-way messaging, and InFLEXion™, the transport protocol enabling advanced voice and data messaging. AMSD will take Motorola's FLEX-based, one-way paging products and adopt the FLEX technology for advanced messaging solutions.

Headquartered in Fort Worth, AMSD is chartered with developing protocol transport, infrastructure equipment, and advanced messaging subscriber devices for the new narrowband PCS services.

In an effort to increase market momentum and to promote innovation, Motorola has openly licensed the FLEX family technology. To date, Motorola has agreements with the majority of nationwide spectrum auction winners to provide infrastructure and subscriber equipment for advanced messaging. The first advanced messaging service available to end users will be two-way messaging. With the unveiling of the first nationwide, two-way, commercial network (expected the middle of this year), end users will have the option of moving from today's one-way pagers to advanced two-way messaging. What does this mean to service providers and end users?

Increased Channel Capacity

Service providers will be able to offer customers the value-added service of response capability, but perhaps

What Can You Expect From Narrowband PCS?

In July 1994, the Federal Communications Commission (FCC) held its initial auctions for licenses for nationwide narrowband personal communications services (PCS). Ten licenses were awarded to six carriers: PageNet (3), Destineer (2), KDM Messaging Co. (2), AirTouch Paging (1), BellSouth Wireless (1), and PageMart (1).

Consumers and the industry can expect services to be on line in some areas as early as mid to late 1995. With the advent of these carriers and their

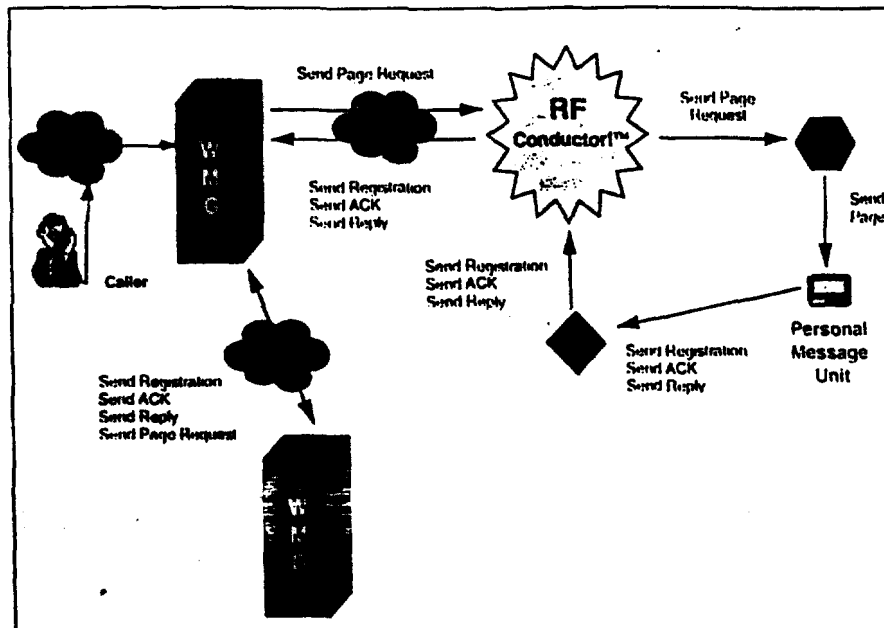


Figure 1. The message flow within a two-way system.

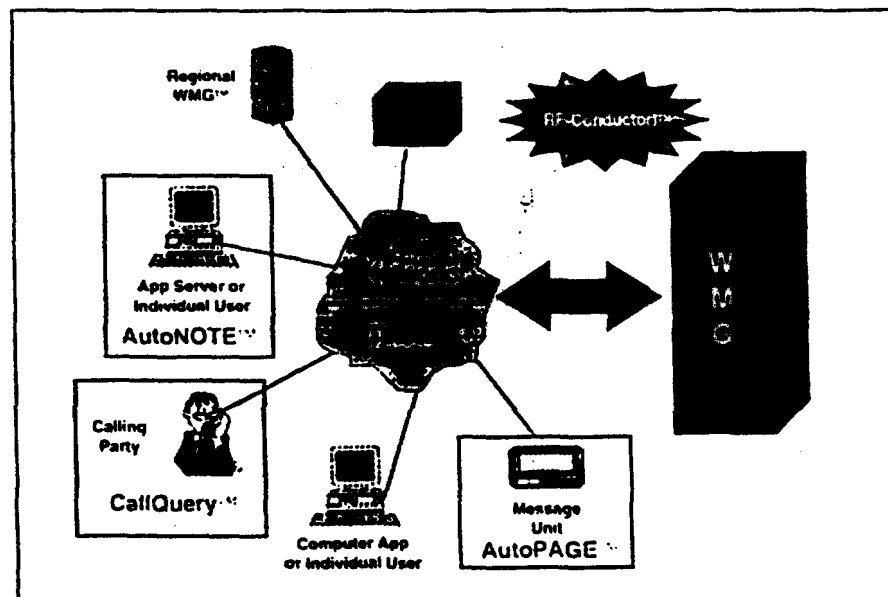


Figure 2. The three response techniques in WMC™.

services, new products also will be introduced to the marketplace. Motorola's Tango pager (see story) is one of the first manifestations of these new services.

What will be the role of narrowband PCS, and what will the markets be? With the introduction of narrowband PCS comes numerous projections about its potential. According to research firm Arthur D. Little Inc., there will be nearly 20 million wireless data products in service by 2002.

In a recent presentation at a Frost & Sullivan conference on mobile communications, A.D. Little suggested services that companies could consider

offering in the narrowband spectrum range from existing "alert" functionality - such as tone alert paging - to limited voice communications to two-way wireless data communications. As price increases so does functionality. A.D. Little lists the range of services appropriate for narrowband PCS - moving from lower price and less functionality to higher price and more functionality - to include tone alert paging, CT-2, numeric display paging, enhanced CT-2, alphanumeric paging, enhanced paging (voice, message back), and mobile data.

Narrowband PCS provides the opportunity for companies to extend current business services and develop new ones. Enhancements of current services could include providing integrated store-and-forward capability for e-mail, voice mail, and fax mail boxes; providing more geographic coverage by acquiring paging properties; numeric to alphanumeric conversions; and adding broadcast information capability and selective address delivery of information to message terminals.

New business opportunities using narrowband PCS could include providing two-way services; applying for and using advanced message service spectrum for services such as wireless e-mail; integrating with voice services to provide enhanced offerings; and offering wireless services in unlicensed spectrum to make available wireless local area network (LAN) and wireless PBX services to subscribers.

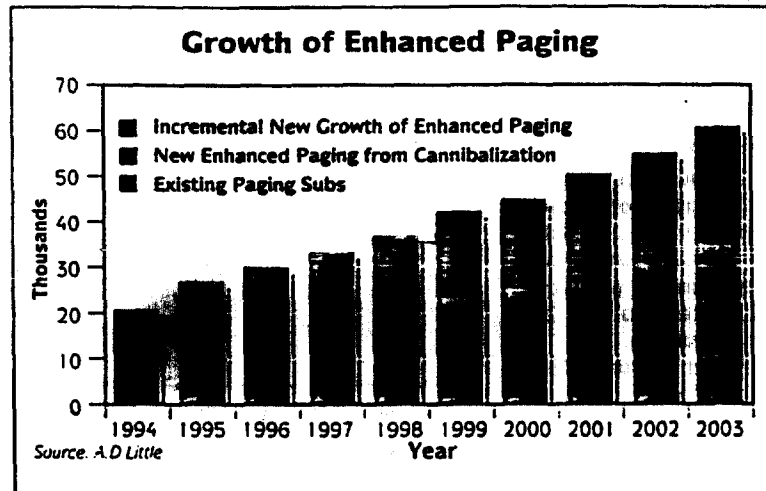
A.D. Little also forecasts the demand

for two-way messaging will approach 10 million subscribers after 10 years of service deployment. PCS subscribers will look for services that provide immediate message notification; forward messages to portable devices;

and from increased demand based on new applications and uses for service. While a great deal of enhanced paging's growth will come from existing users, that user base is also expected to continue increasing as more first-time users are added.

Demand for new services will play a large role in determining the direction of narrowband PCS as service providers and manufacturers look to the end users to find out what does and does not work. In conjunction with this, the cost and technology necessary to support the demand must also be considered. Narrowband PCS will provide a new arena with lots of opportunities for technological advances that will benefit the end user.

- Kelley A. Richardson



and provide voice mail backup, message back, and alphanumeric display.

Of these services, studies forecast enhanced paging represents the greatest revenue potential. Growth of the enhanced paging segment will come from "cannibalizing" existing services

more appealing to service providers will be their ability to increase the capacity of their existing channels. Motorola's ReFLEX transport builds on the foundation of a forward channel protocol that has much in common with FLEX, but adds support for and interworking with a reverse channel. ReFLEX allows wide area coverage for two-way advanced messaging via an inbound channel and associated base receiver. This inbound channel enables the messaging unit to automatically register the location of the user and confirms receipt of each message without any subscriber action. In addition, ReFLEX allows the subscriber to reply to a message as well as initiate unsolicited messages through the two-way messaging unit preprogrammed message set or via external keyboard (PC) input. The ReFLEX protocol supports a "Where are you?" message that allows the system to pinpoint the location of a subscriber within a geographical area prior to sending a long message. This allows the infrastructure to use a single transmitter to send the message, saving on unnecessary broadcasting and thereby enabling increased capacity through frequency reuse (see Figure 1).

ReFLEX provides two-way communications but not in the same sense as traditional symmetric two-way data systems. It is asymmetric because the data rate from the individual subscriber

device into the system is kept low to concentrate the transmitted power in a smaller effective bandwidth. This is done to minimize the number of base receiver sites required to achieve coverage equivalent to that on the outbound channels.

AMSD is developing a full line of infrastructure equipment which will allow service providers to increase their business by offering value-added services, including two-way and advanced-voice messaging. AMSD's wireless solution, The Wireless Concert!™, is Motorola's complete advanced messaging system. It includes:

- **Wireless Message Gateway™ (WMG™)** - the administrator, which accepts voice and data messages over wirelines, compresses voice pages for transmission, maintains a subscriber registration/location database, communicates with other paging terminals or directly to its RF-Conductor!™ (depending on the subscriber's location) and returns the message received status and any subscriber reply message back to the originator.

- **RF-Conductor!** - the controller which batches and schedules outbound messages, coordinates inbound responses and messages with the outbound messages, performs re-transmissions as required, and returns message status and replies to the WMG.

- **Nucleus™-Orchestra!** - the base

station which is capable of handling FLEX, ReFLEX, and InFLEXion transmission protocols.

- **RF-Audience!™** - the receiver which receives transmissions from subscriber units and has a diversified antenna scheme to increase sensitivity.

- **RF-Usher!™** - the receiver concentrator which receives transmissions from multiple RF-Audiences! in a particular geographic area, pre-processes received messages into a more efficient format, and funnels this information to the RF-Conductor! directly or to the WMG for delivery to the RF-Conductor!.

Response Techniques

Once a message has been sent, message status and reply acknowledgment back to the sender is a function of the paging terminal. In WMG, three response techniques are supported: CallQuery™, AutoPAGE™, and AutoNOTE™ (see Figure 2). With CallQuery, the sender is given a transaction ID number when the message request is introduced to the WMG over the telephone. At some point subsequent to leaving the message, the sender calls back to the WMG and queries the status of the message. The WMG informs the caller if and when the message was received and optionally read. If the message was sent to a two-way messaging unit and the subscriber responded with a preprogrammed response,

the WMG "speaks" the reply to the caller. All of the dialogue between the caller and the WMG is provided through voice response and text-to-speech technologies.

With AutoPAGE, the WMG asks the caller if they are also a subscriber of the service provider they have called, and if so, what is their personal identification number (PIN) number. If the caller is an alpha subscriber, correspondence is fairly straightforward. The WMG still provides the caller with a transaction ID and prefixes the "page reply" with the transaction ID and PIN number of the responding subscriber. If the caller is a numeric only subscriber, the WMG sends a coded numeric reply. With AutoNOTE, the sender initiates the message from electronic mail over the Internet. WMG replies to the sender with the appropriate responses.

Tango Arrives

AMSD has also developed the world's first two-way, advanced messaging unit - Tango™, which is approximately the same size as belt-worn alphanumeric pagers and has a flip-top cover housing the transmit antenna. Tango supports up to 120 preprogrammed (canned) inbound, outbound, and bidirectional channel messages as well as a serial connection that can eas-

ily be connected to a printer for message printing or to a personal computer for customized and/or extended length replies and messages. In addition, Tango can initiate messages (via the data port) that are then routed by the service provider to other wireless or wireline destinations, ultimately acting as a wireless modem.

The end user benefits of ReFLEX and two-way messaging are significant. End users will have the traditional advantages of paging coupled with on-the-spot response capability, as well as the ability to initiate a new message.

AMSD also is developing a new high speed voice and data protocol, called InFLEXion, which utilizes linear modulation. It will support greatly increased capacity for voice paging and data messaging. InFLEXion requires advanced messaging infrastructure equipment with an initial end user product offering of a voice paging subscriber device - an answering machine on the belt.

This new advanced messaging infrastructure supports and complements traditional or one-way paging. These new systems will support existing protocols, while offering one-way subscribers some of the conveniences of two-way messaging. The system design is such that one- and two-way subscriber devices can co-exist and

AutoPAGE message replies can be received by today's in-the-field units. However, it is anticipated that the increased capabilities of two-way messaging units, with supporting application software and content (expected to be provided by online services), will quickly transition more users to these new devices.

As with other industries, paging has experienced significant technological advancements over the past decade. Advanced messaging will supply more value-added benefits that will help take narrowband PCS to the next level. □



About the Author

Mike Maloney is Motorola's senior director, marketing and technology. He has extensive experience in

product plan-ning, business strategy, marketing and sales and product development.

June 5, 1996

NORTEL

Mr. Jot Carpenter
Vice President, Government Relations
Telecommunications Industry Association
1201 Pennsylvania Avenue, NW
Suite 315
Washington, DC 20044-0407

Dear Jot:

The following information is responsive to our discussion concerning features on Nortel products which may assist in overcoming impairment of sight, speech, hearing, motion, and other disabilities.

Analog Corded Telephones

All Nortel telephones are ADA compliant

Visual Impairment

- Voice Tags which announce caller name based on Caller ID (M9516)
- Preferred Name Matching of Caller ID (works in conjunction with voice tags)
- Braille dot on middle key
- Display Contrast controls
- Distinctive Key sizing

Hard of Hearing

- Caller ID Name and Number Display
- Call Waiting ID Name and Number Display
- Soft Function Key capability
- Large LED 's for Visual Ringing Indication and Visual Message Waiting Indication
- Large Extension in Use Indication (LED)
- Enhanced Volume to 18 decibels on some products
- Screen Based service capabilities vs. Interactive Voice Response
- Call Director Feature (M9417, M9516) allows switching of incoming call to TDD device based on distinctive ringing
- All products are T-Coil adaptable (Hearing Aid compatible)
- Adjustable ringing tone frequencies

- Seperate volume controls for handsets and handsfree
- ICON Displays
- Visual cues (menu-driven displays)

Motion Impairment

- Automatic Telephone Dialing (via Directory or Autodialers)
- 1 touch feature access (no multiple key presses required)
- Automated Attendant functionality (M9516)
- Cordless Mobility
- Cordless Intercom / Paging capability

PCS Wireless Telephones

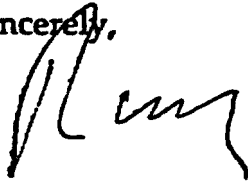
- Caller ID Name and Number Display
- Visual Ringing
- SMS (Short Message Service) text messaging
- Message waiting ICON for voice or text messages
- Adjustable volume
- Adjustable ringing tone frequencies
- Adjustable ringer volume

Also, Nortel is taking a lead role in working with user groups to make GSM phones more compatible with hearing aids.

In a separate letter, I will be sending you product literature concerning Nortel's handset the Maestro EV 1900 designed to assist the hearing impaired.

Please call me if you have any questions.

Sincerely,



Raymond L. Strassburger
Director, Government Relations - Telecommunications Policy
RLS/gj

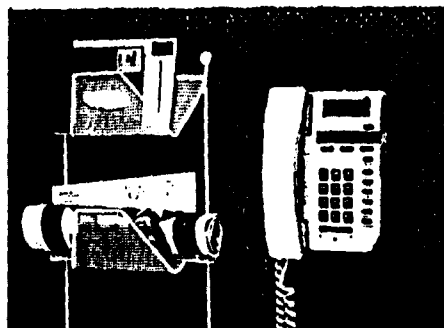
cc: Steve Brock



If you have hearing difficulties, the Maestro 1500 EV makes it easier to communicate with family and friends. Featuring a special receiver that reaches up to 18 decibels (versus the standard 12 decibels), it delivers crystal clear sound with no need to buy or rent special equipment.

For added convenience, the Maestro 1500 EV "locks in" your preferred volume setting, so it's always adjusted to the right level. This exclusive capability means you'll never miss important information because you're adjusting the volume. It also features ringer tones in three different frequencies, so you can select the tone that's easiest for you to hear.

The Maestro 1500 EV offers quick one-touch access to convenient services like Call Return, Repeat Dial, and Three-Way Calling. It's also equipped with Caller ID, so you'll know who's calling before you lift the receiver. Best of all, you'll be able to hear them loud and clear!



If counter space is limited, the Maestro 1500 EV can be easily mounted on the wall.

Choose from three colors: Almond, Charcoal, or Blue.

NORTEL

Nortel and Maestro are trademarks of Northern Telecom.

Information is subject to change since Northern Telecom reserves the right to make changes, without notice, in equipment design or components as progress in engineering or manufacturing methods may warrant.

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1-800-4 NORTEL

Northern Telecom
Department 4364
P.O. Box 13010
Research Triangle Park, NC 27709



NORTEL



MAESTRO 1500 EV
NO MORE STRAINING
TO HEAR YOUR CALLERS!
NO MORE ASKING THEM
TO SPEAK LOUDER!


SPECIAL FEATURES

- Adjustable receiver and finger volume control
- Four selectable finger tones
- Large easy-to-read display
- Flashing incoming call indicator
- Hearing aid compatible

Two-Line Display shows:

- The name and then the number of each incoming caller, or the preferred name you've stored in an autodialer
- The date and time
- The number you've dialed
- Information stored in the Call Log
- Names and numbers you've stored in the autodialers
- Prompts for using features
- Call time information

Options lets you select from four different ring tones and customize your telephone's features.

 Volume lets you increase the receiver volume up to 18 decibels—and retain the setting from call to call. It also acts as a scroll bar for moving left or right through the information displayed on the screen.

Feature Keys give you fast, easy access to the most popular services offered by your telephone company:

- Call Return dials back the last person who called you
- Repeat Dial continuously dials a busy line
- Three-Way Calling lets you talk to two different people at the same time
- Messages lets you access your voice mailbox

Flash makes it easy to use Call Waiting or other services, and reduces the chance of accidental disconnects.

Dial automatically calls the number on the display.

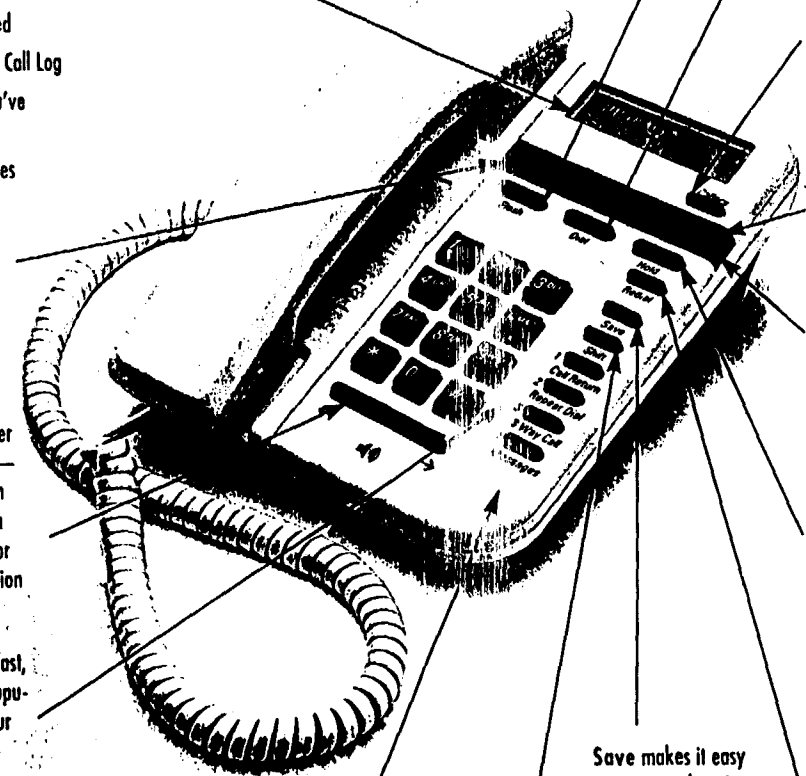
Call Log stores the names and numbers of 10 callers—with the time they called and the number of times they tried to reach you. Press the Callers button to scroll through the list.

Message Waiting Indicator lets you know a new message has been left in your voice mailbox.

Line-in-Use Indicator remains steady when another extension is in use. It also flashes when a call comes in or someone is on hold.

Hold lets you place a call on hold, then pick up at an extension. You can also use this key to insert a "pause" in the dialing sequence when programming access codes or other numbers in your autodialers.

Redial automatically dials the last number you called



Autodialers allow quick access to frequently called numbers, emergency numbers, or special network services. Just press the shift key and then one of these four keys.

Save makes it easy to store numbers in each autodialer.

Shift changes the four feature keys into convenient autodialers.

Note: Operation of the caller identification display, Call Log, visual message waiting indicator, and feature keys requires subscription to certain telephone company services.